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## A PROPOSED METHOD FOR MARKING MIGRANT BUTTERFLIES

BY F. A. URQUHART,

Royal Ontario Museum of Zoology, Toronto, Ont.

In the late summer of 1940, there was a decided peak in the abundance of the monarch butterfly, *Danaus plexippus* L. Numerous reports were received by the Royal Ontario Museum of Zoology, and a personal investigation proved the abundance of the species; trees bordering the north shore of Lake Ontario in the vicinity of Toronto were literally covered with monarch butterflies.

It has been assumed by writers that the monarch butterfly migrates from the northern to the southern parts of the North American continent; in late summer the migration is southward terminating as far south as the Gulf States and California; in the spring the movement is northward. It is believed that individuals leaving the northern parts of the continent in late summer remain in southern United States throughout the winter and return again in the spring. However, there are no definite data bearing upon the actual migratory route of the species or proof for the opinion that the return spring migrants are individuals that left the northern parts of the continent the previous summer. In an effort to obtain definite data in answer to such assumptions, a method of "tagging" monarch butterflies was adopted.

In 1936 T. B. Fletcher (Ent. Rec., 48:105-106) described a method for tagging butterflies as follows: "A small patch on the upper surface of the right forewing is rubber clear of scales and a small label, written in Indian ink on tracing paper, is attached to it with Canada balsam; the adhesive is allowed to harden and the butterfly then released". If one is dealing with only a few individuals, the above method may prove satisfactory; if a large number of individuals has to be considered, then such a method is not satisfactory owing to the time taken in clearing a portion of the wing of scales, applying a layer of Canada balsam, then a ticket, and finally allowing the balsam to dry. In attempting to follow this method, pieces of gummed paper were applied to a portion of the wing from which the scales had been removed; it was found that the label tended to curl on drying and finally fell from the wing. The method finally adopted was to punch a small hole, by means of a paper punch, three-sixteenths of an inch in diameter through the right forewing near the base of the latter and immediately behind the stout radial vein. Care had to be taken not to break the vein. The label was then bent over the front margin of the wing and glued through the hole. The label was made of light weight paper, three-sixteenths by seven-sixteenths of an inch, gummed on one side and bearing the following printed information on the other: "Return to Museum of Toronto, Ont. No. ." The time taken to apply the label, from the capture of the specimen until its liberation, was fifteen seconds. Each tag bore a number referring to the notes concerning the time and place the specimen was tagged.

Observations on the flight of the monarch butterflies bearing labels revealed no apparent hindrance to flight or activity; on a number of occasions, specimens taken in the act of feeding upon a flower would return to the same flower and continue feeding after being handled and the data label applied to the wing. Specimens returned to the museum showed that the label remained

intact even though some of the specimens had been so roughly handled by their captors that the wings were badly torn.

It was estimated that the migratory flight commenced around August 21, this being the earliest record of congregations on trees bordering Lake Ontario on Toronto Island. From August 28 to September 21, it was a common sight to find branches of trees in the vicinity of Toronto laden with monarch butterflies; it was during this period of time that over a thousand specimens were tagged. By September 25 there were relatively few monarchs found in the vicinity of Toronto.

Field observations revealed some interesting facts. Specimens observed flying overhead tended to fly in a south-westerly direction and at an altitude of from 100 feet to the limit of vision. During the forenoon, from 10 until 12 noon, specimens were found actively feeding upon various flowers; in the afternoon there were relatively few individuals on flowers, but a great many could be seen flying overhead. With the setting of the sun, the monarchs congregated on the leeward side of the trees bordering Lake Ontario; it was at such times that tagging proved most successful for it was an easy matter to obtain a number of specimens in a short time. When a strong south wind was blowing, the monarchs came to rest upon the sheltered sides of the trees, such taking place even in the afternoon. On the other hand, a strong north wind favoured migration and few specimens were found upon the trees at such times.

During the past summer the milkweed, *Asclepias syriaca* L., the host plant of the larvae of the monarch, was most abundant. It was found growing in situations where it had not been found previously by the writer. It may be conjectured that the summer of 1940 was favourable for the growth of the milkweed and that this increased food supply resulted in an increased population of monarch butterflies.

Observations made during the summer indicated that in southern Ontario there are two broods of monarchs. On July 15 females were observed ovipositing and larvae of various instars were found throughout August. It may be concluded, therefore, that there is an early summer brood of adults, the offspring of the spring migrants, and a late summer brood of adults, the offspring of the early summer adults. The early summer brood is non-migratory and the late summer brood is migratory.

So far only seven tagged specimens have been returned, and these were all taken in the vicinity of Toronto. With two exceptions, all of the specimens received were taken some distance west of the point where they were tagged. It is hoped that there will be a few returns from the United States, but it is realized that a thousand tagged individuals is comparatively insignificant when dealing with a population of countless thousands.

In order to obtain sufficient data on the migration of the monarch butterfly, it is the writer's hope that entomologists in southern United States will adopt a method similar to that described in the present paper of tagging butterflies now resident in their locality and that during the summer of 1941 the tagging of monarch butterflies will be carried on in various parts of the United States and Canada.

# THE *HIPPELATES* FLIES OR EYE GNATS: PRELIMINARY NOTES*

BY CURTIS W. SABROSKY,†

Michigan State College, East Lansing, Mich.

The *Hippelates* flies or eye gnats are dipterous insects of considerable interest to medical entomologists and public health workers because of their relation to the transmission of yaws and epidemic eye diseases, and because of their persistently annoying habits. The writer has been engaged in studies leading to the preparation of a comprehensive, illustrated monograph of the group in the western hemisphere, a work long needed because of the close similarity of the many species and the difficulty of proper determinations from the literature. Inasmuch as there is immediate need for certain names and notes in connection with various reports, it seemed desirable to make these available at once. Detailed notes, figures, distribution and acknowledgements will be presented in proper setting in the monographic treatment.

## PROVISIONAL KEY TO THE HIPPELATES FLIES OF THE UNITED STATES

1. Antennal arista ensiform, broad and flattened (southeastern U. S.) ..... *Ceratobarys eulophus* (Loew)
   Arista slender, pubescent or haired ..... 2.
2. Bristles of the head long and conspicuous; ocellar bristles very long, proclinate and widely divergent; fronto-orbital bristles inclined forward and outward over the eyes; one or two pairs of intrahumeral bristles present; hind tibial spur short and inconspicuous ..... *Lasiopleura* spp.
   Cephalic bristles short, weak and not conspicuous; ocellars very short, erect, and convergent or cruciate; fronto-orbital hairs minute, slightly reclinate; no intrahumeral bristles present; spur generally stout and distinct (*Hippelates s. l.* ..... 3.
3. Small reddish species with small hind tibial spur ..... 4.
   Body black, or yellow and black with long spur ..... 5.
4. Second costal sector long, twice the length of the third sector; mesonotum deep yellow with three distinct lines of punctures, the median line darkened; frontal triangle pollinose with a narrow polished area between the median ocellus and the apex of the triangle (Texas, N. Mex.) ..... *H. impressus* Becker
   Second costal sector shorter, about 1½ times the length of the third sector; mesonotum entirely darkened, with no trace of lines of punctures; triangle polished black except for the basal corners and the ocellar triangle, the shining area broadly cordate (Neotropical; Brownsville, Tex.) ..... *H. tener* Coq.
5. Thorax entirely black, polished and shining, at most a trace of pollen at the base of the wing (*pusio* group) ..... 6.
   Thorax more or less pollinose, with at least prealar and prescutellar areas of pollen ..... 12.

### *pusio* group

6. Legs entirely pale lemon-yellow; hind tibial spur weak, short, at best barely subequal the greatest diameter of the tibia ..... 7.
   Legs usually more or less extensively marked with black, never pale lemon-

†The writer is under deep obligation to Mr. David G. Hall of the Bureau of Entomology and Plant Quarantine for his splendid cooperation and for generously turning over an unpublished manuscript and material on new species of *Hippelates* in order that the study might be as comprehensive as possible.

yellow though sometimes entirely deep yellow to orange; spur usually strong and black, longer than the diameter of the tibia ..... 8.

7. Cheek sublinear, silvery pollinose (Neotropical) ..... *H. flavipes* Loew.
Cheek broader, not sublinear, with a narrow glossy area adjacent to the eye (eastern U. S.) ..... *H. pallipes* (Loew)

8. Hind tibial spur only slightly curved, closely appressed at the apex of the tibia, the latter not angulate at the insertion of the spur; typically only one row of piliferous punctures between the median and each dorsocentral row ..... 9.
Spur strong and decidedly arcuate, not closely appressed, the apex of the tibia decidedly angulate to receive the spur; typically two or more rows of piliferous punctures between the median and each dorsocentral row 10.

9. All coxae and femora black, the tibiae in part; the mesonotal rows of punctures appear incised, accentuating the row formation (far western U.S.) ..... *H. robertsoni* Sabr., n. sp.
Fore coxae and legs entirely or predominantly deep yellow to orange, occasionally the mid and hind femora infuscated; the rows of mesonotal punctures not incised (eastern U. S.) ..... *H. bishoppi* Sabr., n. sp.

10. Abdomen predominantly orange, with only a median or with a median and two lateral rows of narrow black-brown spots; typically large species with the mesonotum densely punctured (southeastern U. S.) ..... *H. bicolor* Coq.
Abdominal segments 3-5 predominantly black, usually with broad fore marginal bands; mesonotum usually not so densely punctured as to obscure the definition of rows ..... 11.

11.* All coxae, femora and the hind tibiae (in part) typically black or more or less infuscated, occasionally the legs chiefly orange, or with only coxae and middle femora basally blackened; hind tibial spur usually exceeds the apex of the tibia by 1/4—1/3 its length (apparently widespread, especially eastern U. S.) ..... *H. pusio* Loew
Fore coxae and all legs typically deep yellow to orange, occasionally with some infuscation; hind tibial spur usually exceeding the apex of the tibia by nearly ½ its length (southwestern U. S.) ..... *H. collusor* Tns. (or subsp. of *H. pusio*?)

12. Large, bright gray pollinose species; legs almost entirely yellow; proboscis more or less elongate and geniculate; hind tibial spur strongly developed, much longer than the greatest diameter of the tibia (*plebejus* group) ..... 13.
Smaller, dark pollinose species, resembling *Oscinella;* legs chiefly black; proboscis short and fleshy; hind tibial spur small, at most subequal the diameter of the tibia (*dissidens* group) ..... 16.

*plebejus* group

13. Hind tibial spur apical or nearly so; thorax black ..... 14.
Spur distinctly preapical, usually by half its own length, the tibia apically angulate; thorax predominantly yellow, the notum black centrally (Neotropical; Fla.) ..... *H. dorsalis* Loew

14. Frontal triangle gray pollinose; humeri and the margins of the scutellum usually orange to yellow (eastern U. S.) ..... *H. plebejus* Loew
Triangle with one or three bare, polished black areas; humeri and scutellum black ..... 15.

15. Triangle with a narrow, glossy black stripe anterior to the median ocellus; pleura chiefly pollinose (eastern U. S.) ..... *H. nobilis* Loew

*Weakly defined separation. Since the bulk of the populations may be so separated, at least in material now at hand, it seems best for the present to indicate the distinction.

Triangle with three large, circular polished black areas, one beside each ocellus; pleura pollinose above, but polished and bare on the lower half (Neotropical; Fla. and Gulf Coast) ..... *H. proboscideus* Will.

*dissidens* group

16. Mesonotum entirely pollinose ..... 17.
Mesonotum only partly pollinose, at least the anterior third bare and polished ..... 19.

17. Fore coxae yellow; legs chiefly yellow, usually only the hind femora and hind tibiae partially infuscated (far southwestern U. S.) ..... *H. hermsi* Sabr., n. sp.
Fore coxae black; legs almost entirely black ..... 18.

18. Width of the cheeks equal to about 2/3 the height of the third antennal segment and 1/4 the height of an eye (eastern U. S.) ..... *H. dissidens* (Tucker) (=*texana* Mall.)
Cheeks broad, subequal to or wider than the third antennal segment and 1/3 the height of an eye (far western U. S.) ..... *H. microcentrus* Coq.

19. Mesonotum almost entirely polished black, with only a narrow dark prescutellar band of pollen besides the usual prealer patch; cheeks broad, as in *H. microcentrus* (Rocky Mts.) ..... *H. montanus* Sabr., n. sp.
Mesonotum pollinose behind the transverse suture, or with the prescutellar pollinose area continued forward as two dorsocentral lines of pollen; cheeks usually narrower than described above ..... 20.

20. Mesonotum darkly pollinose on the posterior two-thirds, bare and polished anterior to the transverse suture; third antennal segment chiefly yellow; fore coxae yellow, the fore legs usually the same (Neotropical; Key West, Fla. and Bermuda) ..... *H. convexus* Loew
Mesonotum predominantly bare and polished, the bright gray prescutellar pollen extended forward in two narrow lines, giving the appearance of three shining stripes narrowly separated posteriorly by lines of pollen (eastern U. S.) ..... *H. particeps* Becker (=*subvittata* Mall.)

## **Hippelates pallipes** versus **flavipes**

Entomological literature and museum collections abound with conflicting uses of these names. From the types, they are found to be distinct species, with the following important synonymy:

*Hippelates pallipes* (Loew) (*Oscinis*), 1863.
=*H. nitidifrons* Malloch, 1913.
=*H. partitus* Becker, 1912, (♂) (Nearctic records).
Distribution: eastern United States and Canada, from Maine and Quebec westward to South Dakota and south to the Gulf.

*Hippelates flavipes* Loew, 1865.
=*H. angustibuccus* Duda, 1930.
=*H. brasiliensis* Aldrich, 1931.
=*H. partitus* Becker, 1912 (♂) (Neotropical records).
Distribution: Neotropical, from the Bahamas and Central Mexico southward throughout the West Indies and Central and South America to Paraguay and southern Brazil.

The distinguishing characteristics correlate strikingly with the distribution of the two species. The form studied in Jamaica by Kumm and his associates as a vector of yaws, under the name of *pallipes*, is really *Hippelates flavipes*.

**Hippelates robertsoni** Sabrosky, new species

Related to *H. pusio* and *H. bishoppi*, differing from both by the smaller spur and the apparently incised rows of punctures.

Black, shining species, the head dark, only the antennae partially dark orange. Mesonotum comparatively bare in appearance, with only one row of punctures between the median and each dorsocentral position, the rows more sharply marked than in any other known species of *Hippelates*, apparently because the piliferous punctures are deeper and the rows are slightly incised. Legs predominantly black, especially the coxae and femora. Hind tibial spur distinct, black and stout, but short and barely equal to the diameter of the tibia, only slightly curved, and inserted preapically with no angulate emargination of the apex of the tibia. Length, 1.75–2.25 mm.

Type, ♂, and Allotype, San Bernardino National Forest, Alt. 9000 ft., Calif., June 1, 1930 (D. G. Hall). In the U. S. National Museum. Paratypes, 202 specimens from numerous localities in California, Oregon, New Mexico, Arizona, and from Doss and Laredo, Texas, and Sulphur, Oklahoma.

**Hippelates bishoppi** Sabrosky, new species

Near *H. pusio* (see couplet 8 in key).

Shining black species, the head typically black with antennae yellow in part, but the face, cheeks, and front anteriorly, sometimes partially yellow. Mesonotum resembling *H. pallipes*, typically with a single row of punctures between the median and each dorsocentral row, presenting a comparatively bare appearance. Legs chiefly bright yellow, especially the fore coxae and fore legs, sometimes the mid and hind femora infuscated. Hind tibial spur black and moderately strong, slightly curved, preapical but the apex of the tibia not angulate to receive it. Length, 1.25–1.75 mm.

Type, ♂, and Allotype, Zellwood, Florida, May 1, 1939 (J. T. Bigham). Types to be deposited in the U. S. National Museum, through Dr. F. C. Bishopp. Paratypes, 600 selected specimens from many localities throughout eastern United States, especially from Fla., Ga., Ind., Ill., Iowa, Kans., La., Md., Mass., Mich., Minn., N. C., N. Dak., N. J., Oklah., Penn., S. Dak., Texas, and a few scattered specimens.

**Hippelates collusor** Townsend, sp. or susp.

*Hippelates collusor* Townsend, 1895, Proc. Calif. Acad. Sci., vol. 4, p. 619.

*Hippelates collusor* is the valid but long unused name of the abundant and troublesome species in southern California, especially in the Coachella Valley, and which has long been known as *H. pusio*. The so-called "type series", actually the major portion of the original cotypic series, was destroyed in the San Francisco earthquake and fire, but three specimens which are undoubtedly cotypes retained by Townsend are in the Snow Collection at the University of Kansas. One of these is hereby designated as Lectotype. The exact relation to *H. pusio* remains as yet undetermined, but the two are very similar and *collusor* may well be only a weakley defined subspecies.

**Hippelates dissidens** group versus **Oscinella** spp.

Species of the *dissidens* group, with inconspicuous hind tibial spur, have a general habitus which causes frequent confusion with certain species of *Oscinella* such as *O. coxendix* (Fitch). In this connection, the ocellar tubercle offers a useful and easily noted character, at least for our own fauna. The *Hippelates* species have a bare, polished ocellar tubercle, but in *Oscinella coxendix* and its relatives the tubercle is gray pollinose and dull (Sabrosky, 1940, Canad. Ent., vol. 72, p. 215).

**Hippelates hermsi** Sabrosky, new species

Near *H. dissidens,* but with yellow fore legs.

Black species, the anterior half of the front, face, cheeks, palpi, the fore coxae and fore femora entirely, and the other legs chiefly, bright yellow, the color of the legs somewhat variable but most of the infuscation on the hind femora and hind tibiae, the latter with a broad central band. Cheeks narrower than the third antennal segment. Thorax bright gray pollinose, only the lower portion of the pleura and the metanotum centrally, bare and polished. Hind tibial spur black, moderately stout, equal to or slightly longer than the greatest diameter of the tibia, inserted about half its length before the apex of the tibia, but the latter not angulae. Length, 1.25–1.5 mm.

Type, ♂, and Allotype, Coachella, Calif., June 7, 1931 (R. W. Burgess). Types to be deposited in the U. S. National Museum. Paratypes: 60 specimens from seven localities in California and Arizona, and from El Paso, Texas; Indian Spring, Nevada; and Esperanza, Mexico.

**Hippelates montanus** Sabrosky, new species

Near *H. microcentrus,* but the mesonotum chiefly bare and polished.

Antennae entirely black, conspicuous against the dusky yellow to whitish cheeks and face. Cheeks broad, distinctly higher than the breadth of the third antennal segment. Thorax shining black, with a large, bright gray pollinose prealar area as in *H. particeps,* and the scutellum and a narrow prescutellar band dark brown pollinose. Mesonotal hairs long. Coxae and legs subshining black, only the basal tarsal segments lighter in color. Hind tibial spur black, stout but short, less than the diameter of the hind tibia, and inserted almost at the apex of the tibia. Length, 1.5 mm.

Type, ♂, and Allotype, Creede, Colo., alt. 8844 ft., August, 1914 (S. J. Hunter). Types in the U. S. National Museum. Paratypes, 42 specimens from 14 localities in Colorado, California, New Mexico, Nevada, and Utah.

MISCELLANEOUS NOTES

The following notes on other faunas are necessary at this time to explain determinations:

*Chaethippus subannulatus* Malloch, 1934 =*Hippelates stigmaticus* (Duda), 1930 [*Siphomyia*]. New synonym, from the types.

*Hippelates illicis* Curran, 1926 =*Hippelates apicata* Malloch, 1913. New synonym, from the types.

*Hippelates lituratus* Becker, 1912=*Hippelates pusio* Loew, 1872. New syonoym, from the types.

*Hippelates fur* (Williston), 1896 [*Oscinis*], new combination.

*Oscinella Strandi* Duda, 1930=*Hippelates fur* (Williston), 1896. New synonym, from the types.

*Lioscinella buccalis* Duda, 1930, p. 109 =*Hippelates nigripes* (Duda), [*Liohippelates*], 1930, p. 68. New synonym, from the types.

*Hippelates rufescens* (Duda), 1934, new combination (originally described as *Tropidoscinis nitens* var. *rufescens*).

Referred to *Goniaspis* Duda, as new combinations: *Hippelates truncata* Malloch, 1913; *H. scutellaris* Williston, 1896; *H. subaequalis* Malloch, 1913; *H. equalis* Williston, 1896.

# NEW OR LITTLE KNOWN NORTH AMERICAN JAPYGIDAE (THYSANURA)

BY IRVING FOX,
Washington, D. C.

There are few North American insects so little known as the members of the family Japygidae. In the United States the entire family has heretofore been represented by hardly a dozen species and from Canada not a single species has yet been recorded. American entomologists have devoted scarcely any attention to the group, and as a consequence, few collections have been made. Under these circumstances, it was a privilege to have the opportunity to study and report upon a collection of these interesting insects in the United States National Museum. Included in this collection were five new species and three others which are indicated below. All the material upon which this paper was based is in the United States National Museum to the authorities of which the writer expresses his sincere appreciation.

## **Catajapyx diversiunguis** Silvestri, new comb.

1911. *Japyx diversiunguis* Silvestri, Portici R. Scuola Super. di Agr. Lab. Zool. Gen. e Agr. Bol. 5:72, Fig. I.

*New record.* CALIFORNIA, Woodside, February 17, 1935 (P. C. Ting).

The two North American species belonging to the genus *Catajapyx* may be easily separated by the number of segments in the antenna. In the above species there are 26 such segments, while in *C. ewingi* new species, described below, there are 30. Another character by which the two species may be readily distinguished is the dental armature of the forceps.

## **Catajapyx ewingi** new species

Antenna consisting of 30 segments. Sense setae present on segments IV, V, and VI. Teeth of mandible closely appressed, the basal one with its distal end truncate and not separated from the adjacent tooth; distal tooth broad, curved, exceeding the other teeth in length. Outer lamina of inner lobe of maxilla long, curved and simple, the other four laminae pectinate. Setae of body simple. Pronotum with an anterior curved row of seven long setae and a single submedian posterior pair. Metanotum divided anteriorly by a transverse suture in front of which is situated a single pair of submedian setae; posterior to the suture are numerous irregularly arranged setae. Metanotum similar to the mesonotum in arrangement of setae. Legs II and III subequal in length; legs I much shorter than either of the other two pairs. Of the prominent tarsal claws of each leg, one is about two-thirds as long as the other. Abdominal segment I with a subcoxal organ on each side; each subcoxal organ with a transverse row of about 22 setae. Median glandular organ absent. Styli each with a basal seta. Segment IX less than one-half as long as segment VIII. Segment X much longer than arms of forceps. Right arm of forceps armed with a large tooth situated at a place less than one-third the distance from base to apex; proximad of this tooth on the dorsal side is one denticle, while on the ventral side are two denticles; distad of the tooth are crenations but no distinct denticles. Left arm of forceps armed with six denticles of which the most distal is the largest. For further details concerning the dental armature of the forceps see Fig. 2. Total length, including forceps but excluding antennae, about 9.50 mm.

*Type locality.* Howard Co., Arkansas.

*Type material.* Description based on adult holotype taken in peach orchard soil, April 7, 1937, at type locality by W. F. Turner (T-3491) and one adult paratype taken at the same locality on June 9, 1936, by the same collector (T-78) (U. S. N. M. Cat. No. 54834).

### **Evalljapyx propinquus** Silvestri

1911. *Evalljapyx propinquus* Silvestri, Portici R. Scuola Super. di Agr. Lab. Zool. Gen. e Agr. Bol. 5:78, Fig. V.

*New record.* CALIFORNIA, Lancaster, April 26, 1936, "in soil with *Artemisia*" (P. C. Ting).

### **Japyx subterraneus** Packard
(Fig. 4)

1874. *Japyx subterraneus* Packard, Amer. Nat. 8:501.

*New records.* DISTRICT OF COLUMBIA, November, 1936 (J. C. Bridwell). MARYLAND, Plummer Island, November 19, 1925, two specimens (H. E. Ewing); March 3, 1924 (R. C. Shannon). MISSOURI, Oregon Co., November 11, 1937 (W. F. Turner). NORTH CAROLINA, Durham, Duke Forest, March 4, 1939 (A. S. Pearse). VIRGINIA, Hunter, December 7, 1938 (Swezey, Bridwell, and Gurney); Vienna, March 6, 1937, March 26, 1939 (J. C. Bridwell); Rosslyn, November 3, 1940, immature (I. Fox).

### **Japyx tridenticulatus** new species

Antenna consisting of 30 segments. Sense setae present on segments IV, V, and VI. Teeth of mandible distinctly differentiated apically; distal tooth broad, curved, exceeding the other teeth in length. Setae of body simple. Pronotum with an anterior curved row of about seven long setae and a single posterior pair. Setae of meso- and metanotum numerous and irregularly arranged. Legs III longer than legs II which are longer than legs I. Of the two prominent tarsal claws of each leg, one is about two-thirds as long as the other. Abdominal segment I with a subcoxal organ on each side; each subcoxal organ with a transverse row of about 20 setae. Median glandular organ present, consisting of about 27 contiguous disculi. Styli long, acuminate, each with a basal seta. Segment IX about one-half as long as segment VIII. Segment X longer than broad, longer than arms of forceps. Right arm of forceps armed with a prominent tooth half-way from base to apex; proximad to this tooth are three prominent denticles, distad to the tooth are some crenations but no distinct denticles. Left arm of forceps armed with a prominent tooth one-third the distance from apex to base; proximad to this tooth the denticles are arranged as shown in Fig. 3. Total length, including forceps but excluding antennae, about 10 mm.

*Type locality.* Union Co., Illinois.

*Type material.* Description based on adult holotype taken in peach orchard soil, September 16, 1936, at type locality by W. F. Turner (T-862) and one adult paratype from Uvalde, Texas, November 20, 1911 (U. S. N. M. Cat. No. 54835).

This species may be readily separated from the other species of its genus by the dental armature of the forceps.

### **Japyx unidenticulatus** new species

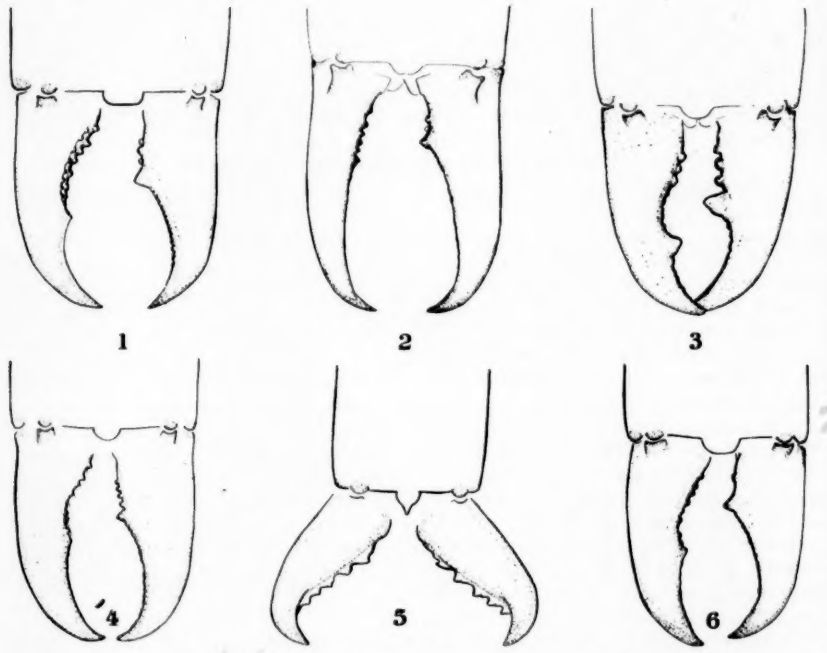
Antenna consisting of 32 segments. Sense setae present on segments IV, V, and VI. Setae of body simple and arranged as in the previously described species. Legs and tarsal claws as in the previously described species. Segment I of abdomen with a subcoxal organ on each side; subcoxal organ of right side with a transverse row of about 12 setae; subcoxal organ of left side injured in only specimen available. Median glandular organ present, consisting of about 11 contiguous disculi. Styli long, each with a basal seta. Segment IX less than one-half as long as segment VIII. Segment X longer than broad, longer than arms of forceps. Right arm of forceps with a prominent tooth located at a place less than one-half the distance from base to apex; proximad to this tooth is a are two denticles; distad to the tooth are a number of crenations but no denticles.

Left arm of forceps armed with nine denticles occupying the basal half. (Fig. 6). Total length, including forceps but excluding antennae, about 10 mm.

*Type locality.* Upson Co., Georgia.

*Type material.* Description based on adult male holotype taken in peach orchard soil at type locality by W. F. Turner (T-8468), November 25, 1937, (U. S. N. M. Cat. No. 54836).

The single denticle on the right arm of the forceps separates this species from the other members of its genus.




(Setae are omitted. All figures show the forceps from the dorsal view with the ventral denticles indicated by dotted lines.) Fig. 1. *Japyx hastatus* new species. Fig. 2. *Catajapyx ewingi* new species. Fig. 3. *Japyx tridenticulatus* new species. Fig. 4. *J. subterraneus* Packard. Fig. 5. *Parajapyx scalpellus* new species. Fig. 6. *Japyx unidenticulatus* new species.

## **Japyx hastatus** new species

Antenna consisting of 32 segments. Sense setae present on segments IV, V and VI. Teeth of mandible distinct apically, the distal tooth larger than the others. Setae of body simple, arranged as in previously described species. Legs and tarsal claws as in previously described species. Segment I of abdomen with a subcoxal organ on each side and a median glandular organ, but these structures are distorted in the specimens available. Styli long, each with a seta located at a place one-third the distance from base to apex. Abdominal segments VIII, IX and X as in previously described species. Right arm of forceps with a prominent acuminate tooth located more than one-third the distance from base to apex; proximad to this tooth on the dorsal aspect is one denticle, on the ventral aspect are two denticles; distad to the tooth are a number of crenations but no denticles. Left arm of forceps with a dorsal and a ventral row of denticles occupying the

basal half. For further details concerning the structure of forceps see Fig. 1. Total length, including forceps but excluding antennae, 9 to 16 mm.

*Type locality.* Upson Co., Georgia.

*Type material.* Described from an adult holotype and four adult paratypes taken in peach orchard soil at type locality by W. F. Turner (T-2524, T-2384, T-2409, T-2321) January 18-22, 1937 (U. S. N. M. Cat. No. 54837).

This species is closely allied to *J. subterraneus* Packard, from which it may be distinguished by the dental armature of the forceps.

**Parajapyx scalpellus** new species

Antenna consisting of 18 segments. No sense setae present on antennae. Mandible with only the distal three teeth distinct. Setae of body simple, abundant on all segments except the caudal three. Legs subequal in length. One of the two prominent tarsal claws slightly longer than the other. Abdominal segment I without a median glandular organ but with a subcoxal organ on each side. Styli each with a basal spur and a basal seta on the opposite side. Segment IX more than one-half as long as segment VIII. Segment X half again as long as wide, and much longer than forceps. Arms of forceps with teeth arranged as shown in Fig. 5. Total length, including forceps but excluding antennae, about 2.00 mm.

*Type locality.* Upson Co., Georgia.

*Type material.* Described from an adult holotype and three adult paratypes taken in peach orchard soil at the type locality on July 23, 1936 (holotype) and July 6, 1936 (paratypes) by W. F. Turner (holotype, T-454; paratypes, T-268a, T-252). (U. S. N. M. Cat. No. 54838).

But two species of *Parajapyx* have heretofore been reported from the United States and Mexico. From both of these, *P. grassianus* Silvestri and *P. minimus* (Swenk), the above described new species may be differentiated by the dental armature of the forceps.

## TESTS FOR TOXICITY OF ARSENICALS AND SODIUM FLUORIDE TO THE AMERICAN ROACH, *PERIPLANETA AMERICANA* L.*

BY HARVEY L. SWEETMAN,

Amherst, Massachusetts

It has been recognized for some time that certain stomach poisons act as contact poisons also. O'Kane and Glover (1935) were among the first to demonstrate that arsenic penetrates the integument of roaches. They give a brief historical account of work preceding 1935. Sodium fluoride has been recommended in this country as an insecticide for the control of roaches since 1915 (Marlatt). It has been assumed for a number of years that sodium fluoride acts chiefly as a stomach poison. The roach was thought to lick the poison from its tarsi and antennae while cleaning them and thus to ingest the poison. This might occur during the process of normal cleaning or perhaps cleaning as a result of irritation produced by the poison. If due to irritation, this suggests that the poison penetrates the integument.

Hockenyos (1933a) found evidence that sodium fluoride penetrated the integument of roaches, but concluded that this was so slight that in control work the roaches would have to secure some poison by licking the appendages to be killed. Hockenyos used a wire screen strait-jacket cage that held the roach without injuring it so that it could not move in any direction. This prevented the roaches from licking their appendages or otherwise removing the poison.

*Contribution from the entomological laboratory of Massachusetts State College.

Very finely powdered sodium fluoride was much more effectively absorbed than was a coarser product.

Munger and Siegler (1937) used a rubber tissue containing a hole through which the head of the roach was inserted. Then the tissue was stretched over a glass cylinder with the head of the roach on the outside. The insecticide could then be placed on any portion of the body and the poison could not come into contact with the mouthparts. By heavily dusting the body and appendages with sodium fluoride, the roaches were killed within twenty-four hours. Lead arsenate produced no apparent injury in twenty-four hours. Check insects with their heads inserted through the rubber tissue were apparently normal at the close of the test period. Neither Hockenyos nor Munger and Siegler tested the tissues chemically for the presence of sodium fluoride.

Munger and Siegler (1937) also tested the possible action of stomach poisons when taken by mouth. The poisons were incorporated in gelatin pills which were offered to the roaches. They were offered no other food but were given water. The roaches were very reluctant to eat the arsenical or fluoride pills. A few roaches died that had access to the arsenical pills, but none that had access to the fluoride pills. Munger and Siegler thought that these few deaths might have been influenced by starvation. Campbell (1939) states that "there is no experimental evidence that sodium fluoride acts as a stomach poison against cockroaches".

*Description of Procedures.* (1). The following procedure for contact poisons was devised to permit the roaches as much freedom as possible during the tests. The mouthparts were sealed to prevent feeding or cleansing activities. The materials used to seal the mouthparts included *Fibriloid, Griswold's Plaster, Ambroid, Duco Cement,* damar, balsam, and celloidin 2% and 8%. The *Ambroid* liquid cement proved most effective as it hardened quickly and effectively sealed the mouthparts. The paper method of holding the roaches described in the next paragraph prevented the feet and antennae from becoming smeared while applying the *Ambroid.* The roaches may be rendered inactive by the use of an anesthetic or by chilling. This assists considerably, as the roaches do not struggle while the *Ambroid* is being applied to the mouthparts. The poison to be tested could then be placed on any portion of the body by any method desired. Following liberation the roach is free to carry on any activity not involving the use of the mouthparts.

(2). Since the roaches tend to avoid food poisoned with arsenical and fluorine compounds (Marlatt, 1915; Munger and Siegler, 1937), measured doses were administered by mouth. The head of a roach, with the antennae pulled back, was forced through a hole in a paper towel just large enough for the head. Then the paper was wrapped snugly about the roach so that it could not withdraw the head or escape. The use of a paper clip or spring clothes pin was sometimes helpful in holding the paper in place. When a drop of fluid and sometimes a solid is placed against the mouthparts the roach will usually chew and swallow the solid or liquid, perhaps as a result of avoidance reactions. Starving the roach a day or two, especially in a dry place, will greatly assist in encouraging it to take moist foods or liquids containing poisons. Various media as carriers of the poisons were tested, but water was usually satisfactory. The poison can be measured by any convenient method dependent upon the media being used. An undetermined amount of the poison may remain on the mouthparts. This error can be reduced with experience in holding the roach and in administering the poison.

*Results of Tests.* These techniques have been followed for the past three years in classwork with undergraduate and graduate students. Typical sets of data are given in tables 1 to 4.

The results in table 1 show merely that roaches are poisoned by external

applications of sodium fluoride, but do not indicate whether poisoning resulted from penetration of the integument or after being taken in by mouth or through both means of entrance. Observations after twenty-four hours would have shown more advanced poisoning of several of the roaches. The single roach coated with fine dust from the floor was apparently normal after twenty-four hours. Further tests with inert materials were not made. Hockenyos (1933b) concluded that dust particles did not enter the tracheae of the Oriental roach. Chiu (1939) has shown that several inert dusts were effective in killing the bean weevil *Acanthoscelides obtectus* Say. These materials apparently produced rapid desiccation and death of the beetles. Similar results from inert materials are shown in the data of Hastings and Pepper (1939) against the Mormon cricket, *Anabrus simplex* Hald. This suggests the possibility that sodium fluoride might injure roaches in a similar manner as well as by chemical action.

The data in table 2 definitely show the contact effect of sodium fluoride on roaches. These results are in agreement with those of Hockenyos (1933a) and Munger and Siegler (1937).

The contact action of arsenicals on roaches is shown in table 3. The poisons were placed on the ventral side of the abdomens with a small hair brush from which the excess poison had been removed by jarring. Toxicities were in relation to the recognized solubilities of Paris green and calcium and lead arsenates. The check roaches lived for 30, 32, 34, 37, and 39 days in a moist jar at 70° F. Four of these roaches were females and deposited one egg capsule each during the test period.

Apparently there are no published data showing that sodium fluoride acts as a stomach poison against roaches (Campbell, 1939). Munger and Siegler (1937) found no evidence that sodium fluoride acted as a stomach poison against roaches. That sodium fluoride definitely acts as a stomach poison against roaches is shown in table 4.

Paralysis of roaches is referred to in tables 1, 2, and 4. The first evidence of deleterious action of sodium fluoride was loss of function of the tarsi, which later might involve greater portions or all of the legs. This loss of function (paralysis) of the tarsi was similar regardless of whether the poison penetrated the integument or was taken in by mouth. The roaches were still capable of walking or running on flat surfaces after loss of function of the tarsi but could not climb vertical surfaces.

*Summary and Conclusion.* A method is described for testing the toxicity of contact poisons by sealing the mouthparts to prevent swallowing of any of the poison. A method for testing toxicity through the digestive tract of poisons that normally are avoided is described, whereby the insects were force-fed. Cockroaches, *Periplaneta americana* L., were used in the experiments.

Three arsenicals and sodium fluoride killed the roaches by contact action. Sodium fluoride definitely acts as a stomach poison after being taken in by mouth.

Table 1. The effects of external application of sodium fluoride on roaches, *Periplaneta americana L.*, that have not had the mouthparts sealed.

| Walking in poison Minutes | Portion of body treated | Immediate response | Result after 24 hours |
|---|---|---|---|
| 2 | ..... | Cleaning | Slightly paralyzed |
| 5 | ..... | Cleaning | Dead |
| 10 | ..... | Cleaning | Slightly paralyzed |
| .. | Antennae | Cleaning | Normal |
| .. | 6 legs | Cleaning | Normal |
| .... | Dorsum | Cleaning | Weak |
| .... | Tip of venter | None | Slightly paralyzed |
| .. | Check | None | Normal |
| .. | Floor dust | Cleaning | Normal |

Table 2. The effects of external applications of sodium fluoride on roaches, *Periplaneta americana* L., with the mouthparts sealed.

| Treatment | Number of roaches | Results in hours | | |
|---|---|---|---|---|
| | | First paralysis | Dead | Normal |
| Dusted | 1 | 2 | 10 | .... |
| Dusted | 2 | 3 | 24 | .... |
| Dusted | 1 | .. | 24 | .... |
| Check | 1 | .. | .... | 24 |
| Check | 1 | .. | .... | 48 |
| Check | 2 | .. | .... | 72 |

Table 3. The effects of three arsenical poisons when applied to the ventral side of the abdomens of roaches, *Periplaneta americana* L., with the mouthparts sealed. (Data secured by Dean Asquith, candidate for the master's degree at Massachusetts State College).

| Poisons | Number of Roaches | Abdominal segments treated | Number dead in hours | | | | |
|---|---|---|---|---|---|---|---|
| | | | 24 | 30 | 36 | 48 | 7 |
| Paris green | 12 | All | 7 | 12 | .... | .... | |
| Calcium arsenate | 12 | All | 5 | 5 | 9 | 12 | |
| Lead arsenate | 10 | All | 1 | 1 | 1 | 3 | 1 |
| Paris green | 5 | Posterior 3 | 0 | 0 | 0 | 2 | |
| Calcium arsenate | 5 | Posterior 3 | 0 | 1 | 1 | 1 | |
| Lead arsenate | 5 | Posterior 3 | 0 | 0 | 0 | 0 | |
| Check | 5 | None | 0 | 0 | 0 | 0 | |

Table 4. The effects of sodium fluoride when force-fed to roaches, *Periplaneta americana* L., in water and alcohol.

| Number of roaches | Sodium fluoride. Drops | Results in hours | |
|---|---|---|---|
| | | First paralysis | Dead |
| 1 | 2—alcohol | 24 | 48 |
| 1 | 4—water | 48 | 72 |
| 1 | 5—water | .... | 48 |
| 1 | check-water | .... | .... |

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# NEW RECORDS OF ODONATA FROM MANITOBA

BY E. M. WALKER,
University of Toronto

Since the writer's list of the Odonata of Manitoba* was published, six species have been added to the fauna of this province and the ranges of some of the species already listed have been considerably extended. Most of these new records are based on the following collections:

1. Forty-four specimens from Churchill, on the coast of Hudson Bay (58°50' N. Lat.), collected in 1936 by Mr. H. Elliott McClure and submitted for identification to the writer by Professor B. Elwood Montgomery of Purdue University, Lafayette, Indiana. All of these with the possible exception of one species were taken on July 18 and are labelled "Bush."

2. Twenty-one specimens from Churchill and vicinity (Gillam), collected in 1937 and 1938 by Messrs. G. S. Brooks of Winnipeg and A. J. Bajkov, Jr., and kindly donated to writer by Mr. Brooks.

3. Thirty-four specimens from Norway House, Lake Winnipeg, and the Berens River (lat. 52°25'), and nine from Churchill, collected by Mr. W. J. Brown of Ottawa and deposited in the National Collection. The Churchill specimens were collected in 1937, the others in 1938.

4. Eleven specimens from Churchill and Ilford, collected by Mr. C. E. Hope of the Royal Ontario Museum in 1940.

## RECORDS OF SPECIES

*Agrion resolutum* Hagen. Churchchill, 2 ♂, 2 ♀, in fragments (H. E. McClure). These individuals are somewhat more heavily marked with black than is usual in specimens from farther south.

*Aeschna eremita* Scudd. Churchill, July 18, 2 ♂ (H.E.M.)

*Aeschna interrupta lineata* Walk. Berens River, July 2, 1 ♀ (W. J. Brown).

*Aeschna juncea americana* Bart. Churchill, July 4, 1 ♂, July 16, 2 ♂ (W. J. B.); July 18, 5 ♂, 13 ♀ (H. E. M.). The females show considerable variation in size and in length of anal appendages.

*Aeschna sitchensis* Hagen. Churchill, June 16, 1 ♀ (W. J. B.); June 30, 1 ♂ 1♀, freshly emerged; July 4, 2♀, both teneral (G. S. Brooks); July 18, 7♀ (H. E. M.); July 28, 1♀ (C. E. Hope). Norway House, June 20, 24, 2♀ (W. J. B.) Berens River, July 30, 1♀ (W. J. B.).

*Aeschna coerulea septentrionalis* Burm. Churchill, June 16, 1 ♀ (W. J. B.); June 28, 1♀ (A. Bajkov Jr.); July 18, 3♂ 1♀ (H. E. M.); July 27, 1♂ (C. E. H.). New to Manitoba but predicted to occur at this latitude. Like the two preceding species it is characteristically Hudsonian but unlike them it appears not to wander south of this zone.

*Hagenius brevistylus* Selys. Berens River, July 2, 2♂; July 10, 2♀ (W. J. B.). This locality is considerably farther north than its limit as hitherto recorded (Lake Nipigon, Ont.)† New to Manitoba.

*Gomphus exilis* Selys. Berens River, July 2, 4♂ 1♀ (W. J. B.). Another species new to the Manitoba list and at its northern limit at this latitude.

*Gomphus fraternus* (Say). Berens River, July 1, 2, 4♂ 4♀ (W. J. B.). This record extends the known northern range of *G. fraternus* very considerably. It was previously unknown north of Victoria Beach, Lake Winnipeg.

*Cordulia shurtleffi* Scudd. Churchill, July 16, 2♀ (W. J. B.) This is the first definite record of this species from the Hudsonian zone.

*Somatochlora minor* Calvert. Gillam, June 22, 2♂ (G. S. B.). Another new record for the Hudsonian zone.

*Can. Ent. 1933, 65: 57-72.
†Walker, Can. Ent. 1924, 56: 175.

*Somatochlora franklini* (Selys). Churchill, June 30, 1 ♀ just emerged (G. S. B.); June 30, 1 ♀ (W. J. B.); Gillam, mile 327 Hudson Bay Railway, June 21, 1 ♂ (G. S. B.). Norway House, June 22, 24, 28, 1 ♂ 4 ♀; July 2, 1 ♀ (W. J. B.). Berens River, July 2, 6, 2 ♀; July 24, 2 ♂ 1 ♀ (W. J. B.)

*Somatochlora kennedyi* Walk. Norway House, June 28, 1 ♂ (W. J. B.). Berens River, July 24, 1 ♂ (W. J. B.).

*Somatochlora whitehousei* Walk. Churchill, June 28, 2 ♂ (A. Bajkov Jr.); July 18, 1 ♂ 1 ♀ (H. E. M.). Another typical Hudsonian species.

*Somatochlora albicincta* (Burm.). Churchill, July 18, 3 ♂ 4 ♀ (H. E. M.); July 28, 1 ♀ (C. E. H.). These are the first authentic records of this species from Manitoba. It is a typically Hudsonian species, although it ranges well into the Canadian zone.

*Somatochlora hudsonica* (Hagen). Churchill, July 16, 1 ♂ (W. J. B.); July 27, 2 ♂ (C. E. H.). Norway House, June 28, 1 ♂ (W. J. B.). New to Manitoba but expected from this region as it is known from British Columbia, Alberta, the Northwest Territories and Northern Ontario.

*Pachydiplax longipennis* (Burm.). Lac Bonnet, July, 1930, 1 ♀ (Miss R. D. C. Martin). This is a new record for Manitoba and a very unexpected one, since in Ontario *P. longipennis* is known only from the extreme south. It also occurs in the southwestern corner of British Columbia.

*Leucorrhinia hudsonica* (Selys). Churchill, June 22, 1 ♂ (W. J. B.); June 28, 7 ♂ 3 ♀ (A. B.). Ilford, June 11, 6 ♀ (C. E. H.). Norway House, June 22, 2 ♀ (W. J. B.).

## A NEW PARASITIC BEE FROM COLORADO

BY T. D. A. COCKERELL,
University of Colorado, Boulder, Colo.

**Epeolus rufulus** n. sp.

*Female.* Length about 8 mm., anterior wing about 5.5 mm. The following parts are ferruginous: labrum, mandibles, lower margin of clypeus, scape, flagellum beneath (above it is dusky reddish), tubercles, scutellum, axillae, area of metathorax (except apical part), upper part of sides of metathorax, region below wings, a very broad band across pleura, legs, first two abdominal tergites and base of third, apex of abdomen and all of abdominal venter. Head broad, transverse; eyes pale grey; clypeus dull, densely punctured; antennae long, third joint about as long as fourth; mesonotum dull and finely, densely punctured, the surface with thin pale hair but no distinct stripes; scutellum prominent, bigibbous; axillae large; tegulae clear red, wings faintly dusky; first tergite with white hair, the anterior band nearly interrupted, the posterior one not even notched, the red bare band straight, about as broad as the apical hair-band; second tergite with a broad band of white tomentum apically, its anterior margin undulate at sides; third and fourth with broad bands; fifth with a silvery transverse mark; apical plate large and broad.

Colorado; Crowley, Sept. 1, 1932 (M. T. James). Type in University of Colorado Museum.

*E. bifasciatus* Cresson, which agrees in the red scutellum and axillae, has a broader, coarsely punctured mesontum and cannot be allied. *E. fulvopilosus* Cameron, from Mexico and Guatemala, has one broad hair-band across first tergite, and the tomentum of abdomen is fulvous. There is a general resemblance to several species of Western America, but the red color, dull finely punctured mesonotum without bands (a circle of pale pubescense is faintly indicated on the disc), the robust scutellum and axillae, the even transverse red band on first tergite, and the dark middle and hind spurs are distinctive.

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